(19) Eur päisches Patentamt
European Patent Office
Office européen d s brevets

(11) Publication number: **0 015 553**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 80101124.8

(22) Date of filing: 06.03.80

(51) Int. Cl.³: B 41 J 29/42, B 41 J 11/46

(30) Priority: 07.03.79 US 18345

(43) Date of publication of application: 17.09.80 Bulletin 80/19

(84) Designated Contracting States: AT BE CH DE FR GB LU NL

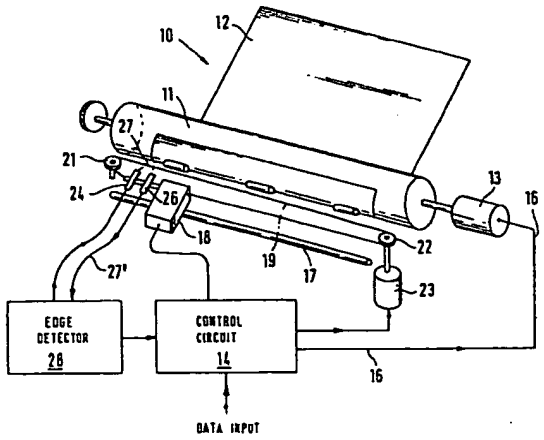
(71) Applicant: VYDEC, INC., 9 Vreeland Road, Florham Park New Jersey 07932 (US)

(72) Inventor: Pedersen, Egon A., 47 Bella Vista, Diablo California 94528 (US)
Inventor: Tilton, Dennis A., 4654 Stratford Avenue, Freemont California 94538 (US)
Inventor: Peerboom, Rene, 19 Brookside Road, Edison New Jersey 08817 (US)

(74) Representative: LOUIS, PÖHLAU, LOHRENTZ & SEGETH, Kesslerplatz 1, D-8500 Nürnberg (DE)

(54) **Method and apparatus for determining the position of the printing medium in a high speed printer.**

(57) A high-speed printer (10) includes a rotatable platen (11) and a movable print carriage (18). The carriage includes a light-emitting diode (24) and a photo-detector (26) which scan the platen, as the carriage moves, looking for the edge of the paper. The light is transmitted to and from the platen by a pair of optical fiber bundles (32, 33) which are randomly interspersed at their forward end to produce a third optical fiber bundle (34).



EP 0 015 553 A1

Method and apparatus for determining the position of the printing medium in a high speed printer

The invention relates to a method and an apparatus for determining the position of the printing medium in a high speed printer.

High-speed printers are widely used in industry for such diverse applications as output devices for data-processing systems, stand-alone word-processing terminals, or interactive terminals for time-sharing systems. Increasingly, such printers are called upon to operate in an automatic or semi-automatic mode, that is to say, with only occasional intervention from a human operator.

For such automatic or semi-automatic operation to be completely reliable it is, of course, necessary for the printer to determine whether or not the printing medium to be used, typically a sheet of paper, has

been properly fed into the printer or, if properly fed at the beginning of the print cycle, has not subsequently gone askew. If, as is often the case, the printer is typing information onto a pre-printed form, it is also important to accurately register the beginning of each print cycle with the pre-printed regions of the form.

Heretofore, the only way to resolve these problems was to use a printer having a tractor-feed platen and sprocketed, fan-fold paper. Unfortunately, this has not proven to be a satisfactory solution to the problem as the paper must subsequently be separated into individual sheets and the perforated egdes removed, all of which adds to the costs of the operation. Further, the requirement that the paper used must be sprocketed greatly reduces the flexibility of the printer as any special paper or letterhead which a customer may wish to use is not compatible with the system and hence cannot be used. Then too, use of sprocketed paper does not necessarily guarantee proper vertikal alignment as the operator may feed the paper into the machine incorrectly from the outset.

What is clearly needed is a method and an apparatus for rapidly and accurately determining the position of the paper in the printer relative to the print head carriage. Advantageously, the method should not be tied to the use of any particular form of paper, nor should the method be restricted to any particular type of printer.

The above and other objectives are attained in the instant invention which comprises an apparatus for detecting at least one of the edges of a printing medium which is positioned proximate the platen of a printer, the printing medium and platen having differing co-efficients of reflection to incident radiant energy. The apparatus comprises means for directing a beam of radiant energy towards the platen and means for detecting any of the beam of radiant energy as is reflected off either the platen or the printing medium. The apparatus also includes means for inducing relative motion between the platen and the beam directing and beam detecting means and means, responsive to the output of the beam detecting means for terminating the relative motion whenever a significant transition is detected in the output from the beam detecting means.

The invention and its mode of operation will be more fully understood from the following detailed description, when taken with the appended drawing in which:-

Figure 1 is a partially isometric, partially schematic view of a portion of an illustrative printer according to the invention;

Figures 2 and 3 are respectively cross-sectional and front views of an optical sensor for use with the apparatus shown in Figure 1;

Figure 4 is a schematic diagram of an illustrative edge detector for use with the apparatus shown in Figures 1 - 3;
and
Figures 5 and 6 are flow-charts illustrating how the apparatus shown in Figures 1 - 4 can be used to find the upper left-hand corner of a sheet of paper placed in the printer.

The invention will now be described with reference to a high-speed printer of the type in which the platen remains stationary and the print head carriage moves relative to the platen. This is by far the most popular arrangement and is exemplified by such well-known printers as the "daisywheel" printer, the "golf-ball" printer and most dot-matrix printers. However, a person skilled in the art will readily appreciate that the same relative motion exists in printers wherein the print head is stationary and the platen is moved. Accordingly, the invention to be described is clearly equally applicable to this latter class of printer.

Figure 1 depicts a partially schematic partially isometric, "exploded" view of a portion of a typical printer which is useful in explaining the principles of the instant invention. The printer shown in this Figure is not intended to represent any specific machine and it will be recognized that for the sake of clarity many structural components have been omitted

from the drawing. However, the omitted elements are entirely conventional and form no part of the claimed invention.

As shown, printer 10 includes a platen 11 for receiving a suitable printing medium, for example a sheet of paper 12. A motor 13, connected to the shaft of platen 11, intermittently advances the paper 12 upon receipt of a line-feed command from a control circuit 14, via line 16.

A slide bar 17, which is mounted parallel to, and slightly below, platen 11, slidably supports a carriage 18. Carriage 18, of course, includes the customary inked ribbon (not shown) and the print mechanism (not shown) which, as we have previously noted, may be any of the known types, such as "daisywheel", "golf-ball", dot-matrix, ect.. Carriage 18 is advanced along slide bar 17 by means of a stainless steel cable 19 which is secured at both ends to the carriage and which passes over a pair of guide pulleys 21 and 22 located at each end of the platen. In the drawing, pulley 22 is shown connected to the shaft of a second motor 23. Motor 23, in turn, is connected to control circuit 14 which sends a signal to motor 23 to advance the carriage after each character has been printed on paper 12. A radiant energy source 24 and a radiant energy detector 26 are mounted to, and travel with, carriage 18. Advantageously, the radiant energy which is emitted by source 24 (and detected by de-

tector 26) is visble light. The light beam 27 from source 24 impinges upon platen 11 and/or the paper 12 and is reflected therefrom back towards the detector 26. The output from detector 26 is connected, via a lead 27', to an edge detector circuit 28 which also connects to an input of control circuit 14.

Typically, platen 11 is comprised of a black, rubber material and, hence, has poor reflectivity to visible radiation. The paper 12, on the other hand, is typically white and, hence, has a high reflectivity. Detector 26 will, thus, generate a clearly defined signal whenever carriage 18 travels over a region of the platen which contains an edge of the paper 12.

Light source 24 may comprise, for example, a light emitting diode, a solid state laser or an incandescent bulb. Detector 26 may comprise a photo-diode or a photo-transistor. It will be appreciated that the light that is emitted from source 24 need not necessarily lie in the visible portion of the spectrum and may, for example, fall within the infra-red or ultra-violet portions of the spectrum. Indeed, in its broader aspects, the radiant energy which is directed onto the platen could comprise radio frequency energy, e.g. a microwave beam, or even ultrasonic energy, provided, of course, that the reflective properties of the platen and paper to the particular type of radiant energy employed are such that the energy which is reflected back into the detector is sufficiently different when the carriage moves from over the platen

to the paper that edge detector 28 can determine, in fact, that a transition has occured.

The choice of the particular kind of radiant energy employed is somewhat a function of the nature of the printing medium used. For example, microwave radiation would be a poor choice for conventional paper but an excellent choice for the metallized paper used in some types of printers. In any event, it will be recognized that optical radiation in the visible spectrum has probably got the broadest all-around applicability.

In some cirumstances, it is advisable to physically remove the radiant energy source and radiant energy detector from the upper end of the print carriage, for example, where there is a physcial clearance problem within the printer. When this is done, the source and detector may be connected to the upper end of the carriage by means of some suitable waveguide, for example, an optical fiber in the case of visible light.

Such an arrangement is shown, for example, in Figures 2 and 3 wherein a housing 31, curved at is upper end and fastened to the print carriage, supports detector 26 and light source 24 at its lower end. A first fiber optic bundle 32 is optically interfaced at one end of the source 24 while a second fiber optic bundle 33 is similarly interfaced to the detector 26. The other ends of bundles 32 and 33 are merged together to form

a semi-randomized bundle 34, which is approximately 2 mm (0.080") in diameter in the illustrative embodiment. The light from source 24 is carried by the fibers of bundle 32 up to the top of the carriage where it is reflected off the paper, if present, and carried back down the fibers of bundle 33 to detector 26. The entire arrangement, including housing 31, is fastened to the print carriage and travels along with the carriage as it steps along the slide bar 17. Electrical connection of source 24 and detector 26 is made by means of a four pin connector 36 and some suitable flexible cable, the other end of which terminates in edge detector 28.

Figure 4 depicts the circuitry of edge detector 28 in greater detail. As shown, source 24 comprises a light-emitting diode connected, via connector 36, between ground and a 5 volt source in detector 28. Detector 26 comprises, for example, an STPT-1520 photo transistor connected, via connector 36, between a 5 volt source and the non-inverting input of an LM 311 operational amplifier 41 in detector 28. The output of amplifier 41 is connected as an input to control circuit 14 and will be high when detector 26 is biased on by light reflected from the paper in the printer.

Modern high-speed printers, particularly those of the "daisywheel" type are typically controlled by an 8-bit micro-processor such as the Intel. 8080 or 8085. In that event, control circuit 14 will comprise the mic-

ro-processor chip, and its associated support chips, with the desired program that the printer it to follow stored in ROM.

With reference to the computer flow chart shown in Figures 5 and 6, a typical sequence of operation for the edge detector equipped printer discussed above might be as follows:

A) Move the carriage to the right to find the left edge of the paper. Typically, the rage of scan will be approximately 33 cm (13 inches), i.e. from the leftmost carriage position to within 5 cm (2 inches) of the rightmost position (assuming a 38 cm) (15 inches) platen).

B) If the left edge of the paper is detected, stop the carriage at the point of detection. Next, rotate the platen in the reverse direction until the top of the papers is detected. At this point, the fiber optic bundle 34 will be pointing at the upper left corner of the page and the co-ordinates of this point can be stored by the micro-processor for future reference. The carriage is then moved to the right and the platen rotated in the normal direction until the appropriate left and top printing margins are set, as dictated by some present value of customary business practise. Printing may now begin.

C) If paper is not detected by the time that the carriage has moved to within 5 cm (2 inches) of the rightmost carriage position, the carriage is moved

to the center of the platen. The platen is then rotated 6,3 cm (2.5 inches) in the forward direction or until paper is detected.

D) If paper is detected in step C, the carriage is moved to the left until the left egde of the paper is reached. With fiber optic bundle 34 now pointing at the upper left hand corner of the paper, printing will begin as in step B above.

E) If after 6,3 cm (2.5 inches) of forward platen rotation (step C) the top of the paper is not detected, the carriage is moved leftward. If paper is then detected, the carriage will continue to move leftward until the left edge of the paper is detected. If this occurs, step B will be executed. If papers is not detected by the time that the carriage reaches the left hand stop, the carriage will then move rightwards. If the left edge is then detected, step B will be executed.

F) If after steps A - E have been executed, paper has not been detected an indicator will be provided, e.g. an alarm such as a bell will be sounded to provide an audible indication, or a flag will be raised to provide a visual indication, and the operator summoned to investigate.

Although not shown in Figures 5 and 6, it is also possible to check for paper alignment by oscillating the carriage about the left hand edge of the

paper while continuously advancing the platen. Obviously, if the detected signal changes this procedure to "all white" or "all black" the paper must be skewed on the platen and an alarm is sounded.

CLAIMS:

1. Apparatus for detecting at least one of the edges of a printing medium (12) which is positioned proximate the platen (11) of a printer (10), said printing medium and platen having differing co-efficients of reflection to incident radiant energy, characterized by
means (24) for directing a beam (27) of radiant energy towards said platen (11);
means (26) for detecting any of said beam (27) of radiant energy as is reflected off either said platen (11) or said printing medium (12);
means (23) for inducing relative motion between said platen (11) and said beam directing and beam detecting means (24, 26); and
means (28), responsive to the output of said beam detecting means (26), for terminating said relative motion whenever a significant transition is detected in said output.

2. Apparatus according to claim 1, where in said radiant energy falls within the optical spectrum.

3. Apparatus according to claim 2, wherein said radiant energy falls within the infra-red portion of the optical spectrum.

4. Apparatus according to claim 2, wherein said radiant energy falls within the visible portion of the optical spectrum.

5. Apparatus according to claim 1, wherein said platen (11) is restrained from lateral motion, said motion inducing means comprises a movable carriage (18) which travels along a path parallel to the axis of said platen, and the apparatus further is characterized by means (31), mounted to said carriage (18), for supporting said beam directing means (24) and said beam detecting means (26) in proximity to said platen.

6. Apparatus according to claim 5, wherein said beam directing means comprises a source (24) of a beam of light and said beam detecting means (26) comprises a photo-detector.

7. Apparatus according to claim 5, wherein said beam directing means comprises a source (24) of a beam of light and first optical fiber means (32), optically coupled at one end to said light beam source, said supporting means (31) positioning the other end of the said optical fiber means (32) proximate said platen (11), said beam detecting means comprising a photo-detector (26) and second optical

fiber means (33), optically coupled at one end to said photo-detector, said supporting means (31) positioning the other end of the said optical fiber means (32) proximate said platen.

8. Apparatus according to claim 7, wherein said first and second optical fiber means respectively comprise first and second optical fiber bundles (32, 33), the ends of the fibers which are respectively remote from said light beam source (24) and said photo-detector (26) being randomly intermingled to form a third optical fiber bundle (34) which is positioned proximate said platen (11).

9. Apparatus according to claim 1, further including means (13) for selectively rotating said platen (11), said motion terminating means including means, operative only in the absence of said relative motion, for activating said platen rotating means (13) and for subsequently terminating the same whenever a significant transition is detected in said output.

10. Apparatus for locating the upper left hand corner of a generally rectangular printing medium (12) in a printer (10), said medium being positioned proximate a rotatable printing platen (11), the printer including a movable print carriage (18) with a source (24) of a light beam and a photo-detector (26) mounted thereto, said method being characterized by the steps of

(a) moving said carriage (18) to its extreme left hand position;
(b) moving said carriage (18) to the right while scanning the platen (11) until the left hand edge of said medium (12) is detected; and then
(c) rotating said platen (11) in the reverse direction while scanning said medium (12) until the top edge of said medium is detected whereby the upper left hand corner of said medium is determined.

11. Method according to claim 10, wherein, if in step (b) above the carriage (18) moves to the extreme right hand position without detecting the left hand edge of said medium (12), the method comprises the further steps of
(d) moving said carriage (18) to the middle of the platen (11) and
(e) rotating said platen (11) in the forward direction while scanning said platen for a predetermined period or until the top edge of the medium (12) is detected; then
(f) if the top edge of the medium (12) is detected, moving said carriage (18) to the left while scanning said medium until the left hand edge of the medium is detected whereby the upper left hand corner of the medium is determined.

12. Method according to claim 11, wherein if the top edge of the medium is not detected in step (e) above, the method comprises the further steps of

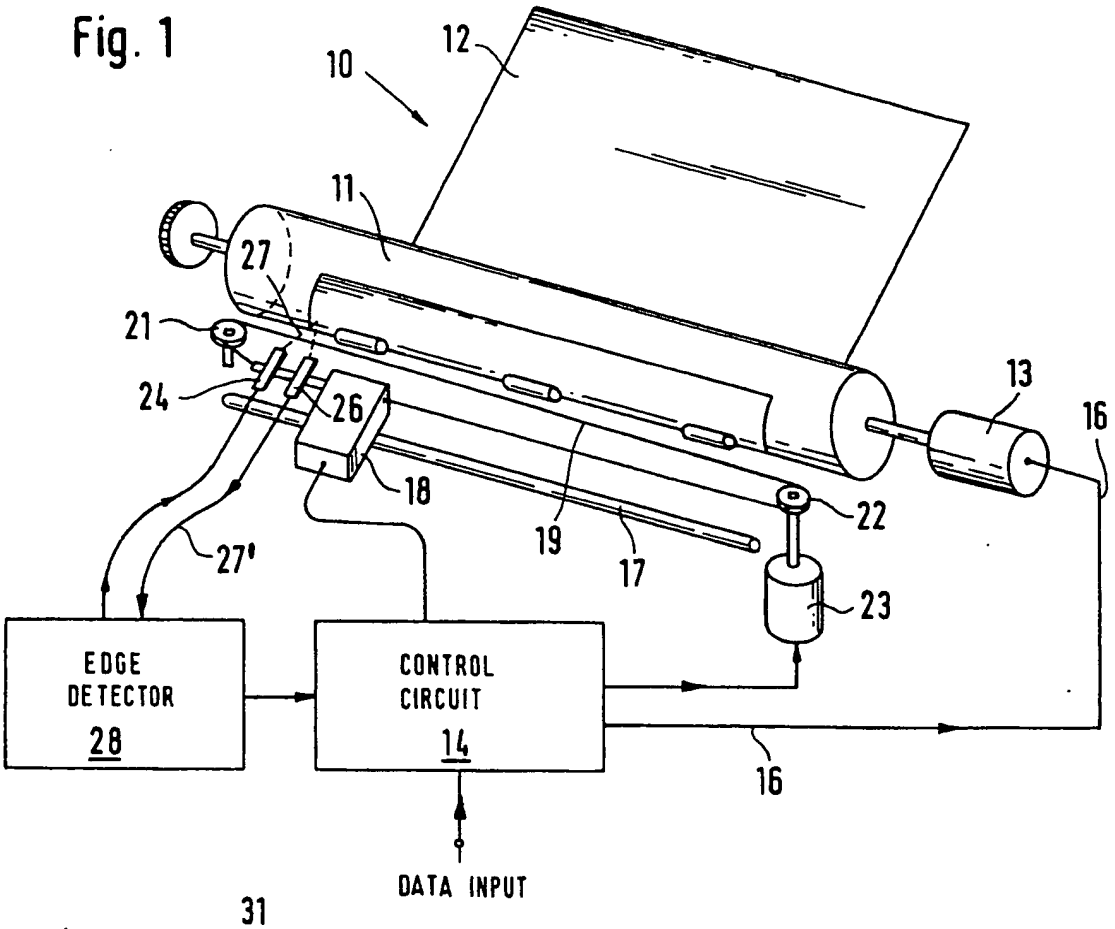
(g) moving said carriage (18) to the left while scanning said platen (11) to detect the right hand edge of said medium (12);
(h) if the right hand edge of the medium is detected, continuing to move said carriage (18) to the left while scanning said medium to detect the left hand edge of said medium (12); and then
(i) repeating step (c) above.

13. Method according to claim 12, wherein, if the right hand edge of the medium is not detected in step (g) above before the left hand step is reached, the method comprises the further steps of
(j) moving said carriage (18) to the right while scanning said platen (11) until the left hand edge of said medium (12) is detected; and then
(k) repeating step (c) above.

14. Method according to claim 13; wherein, if the left hand edge of the medium (12) is not detected in step (j) above, the method comprises the further step of
(l) providing an indicator to summon an operator.

0015553

Fig. 1



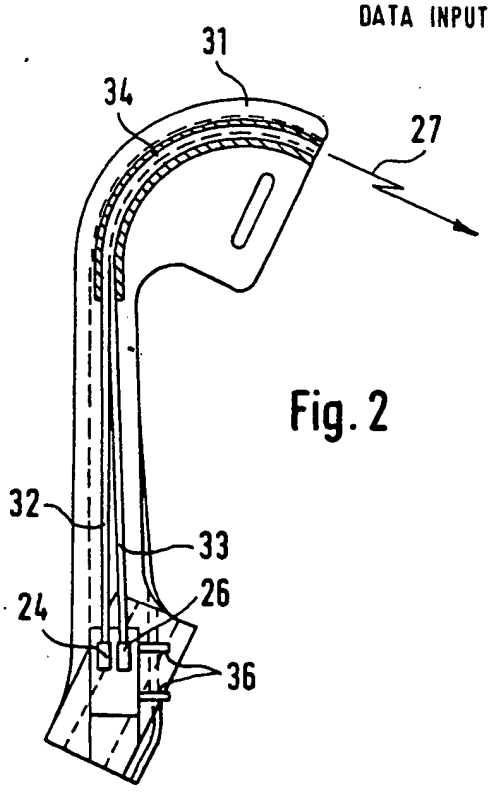


Fig. 2

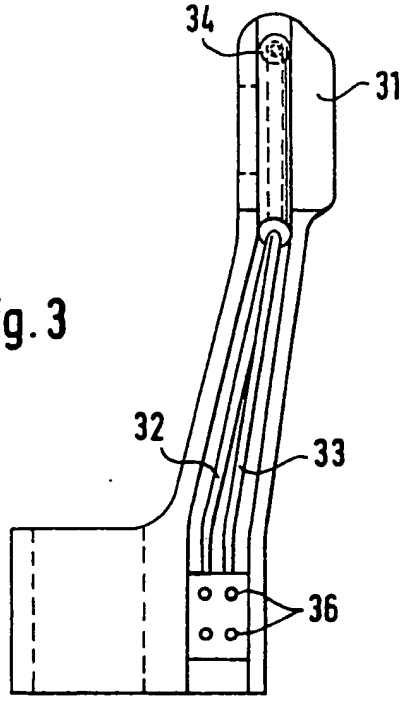


Fig. 3

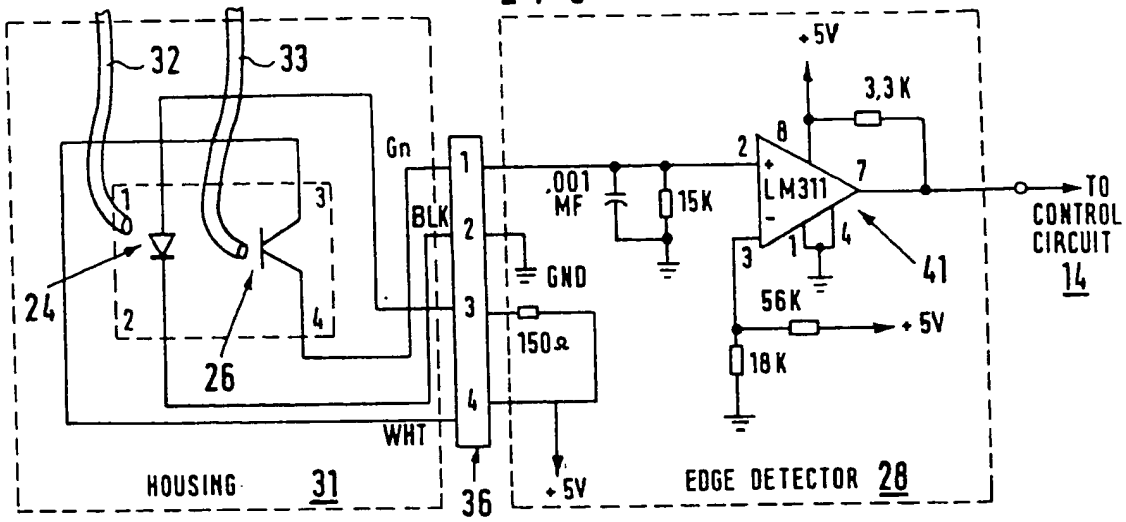

32
33
Gn
BLK
1
2
3
4
24
26
.001 MF
15K
GND
150Ω
WHT
+5V
3.3K
LM311
56K
18K
41
TO CONTROL CIRCUIT 14
HOUSING 31
36
EDGE DETECTOR 28

Fig. 4

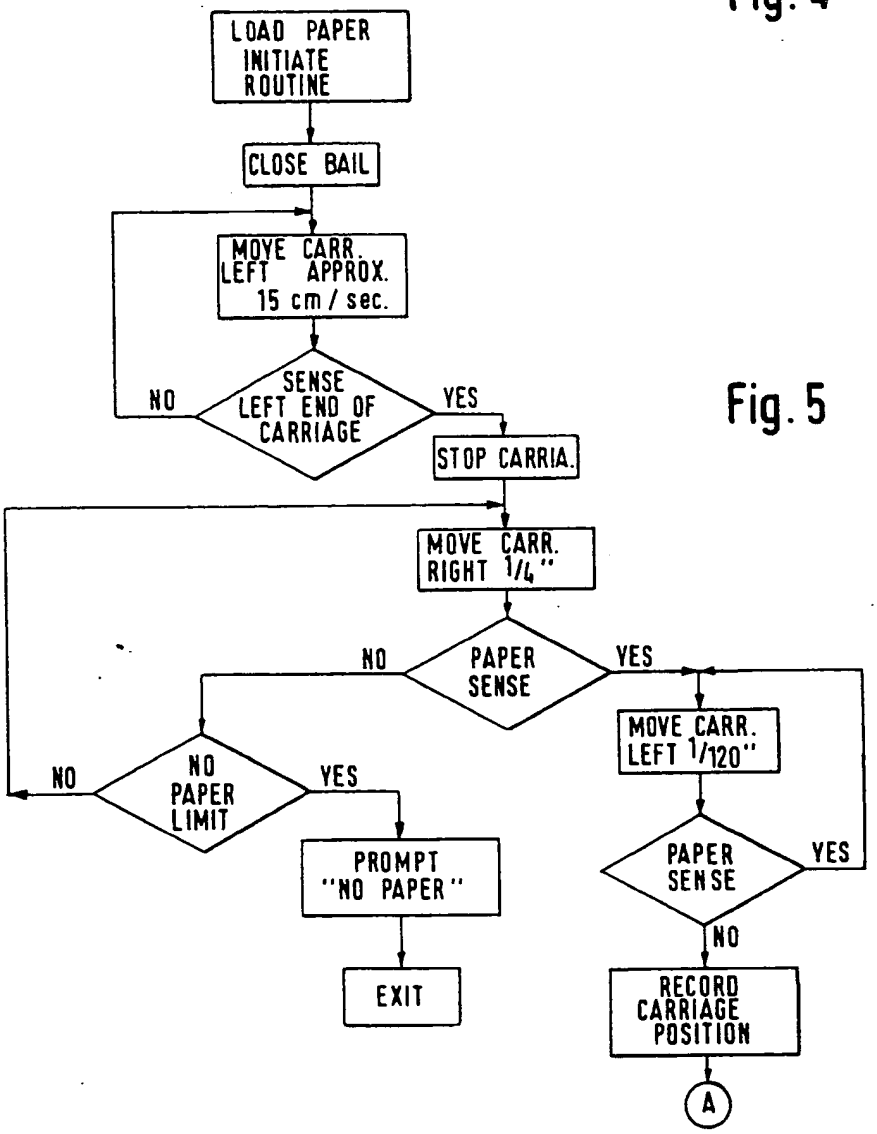

LOAD PAPER INITIATE ROUTINE
CLOSE BAIL
MOVE CARR. LEFT APPROX. 15 cm / sec.
SENSE LEFT END OF CARRIAGE
NO
YES
STOP CARRIA.
MOVE CARR. RIGHT 1/4"
PAPER SENSE
NO
YES
NO PAPER LIMIT
NO
YES
PROMPT "NO PAPER"
EXIT
MOVE CARR. LEFT 1/120"
PAPER SENSE
YES
NO
RECORD CARRIAGE POSITION
A

Fig. 5

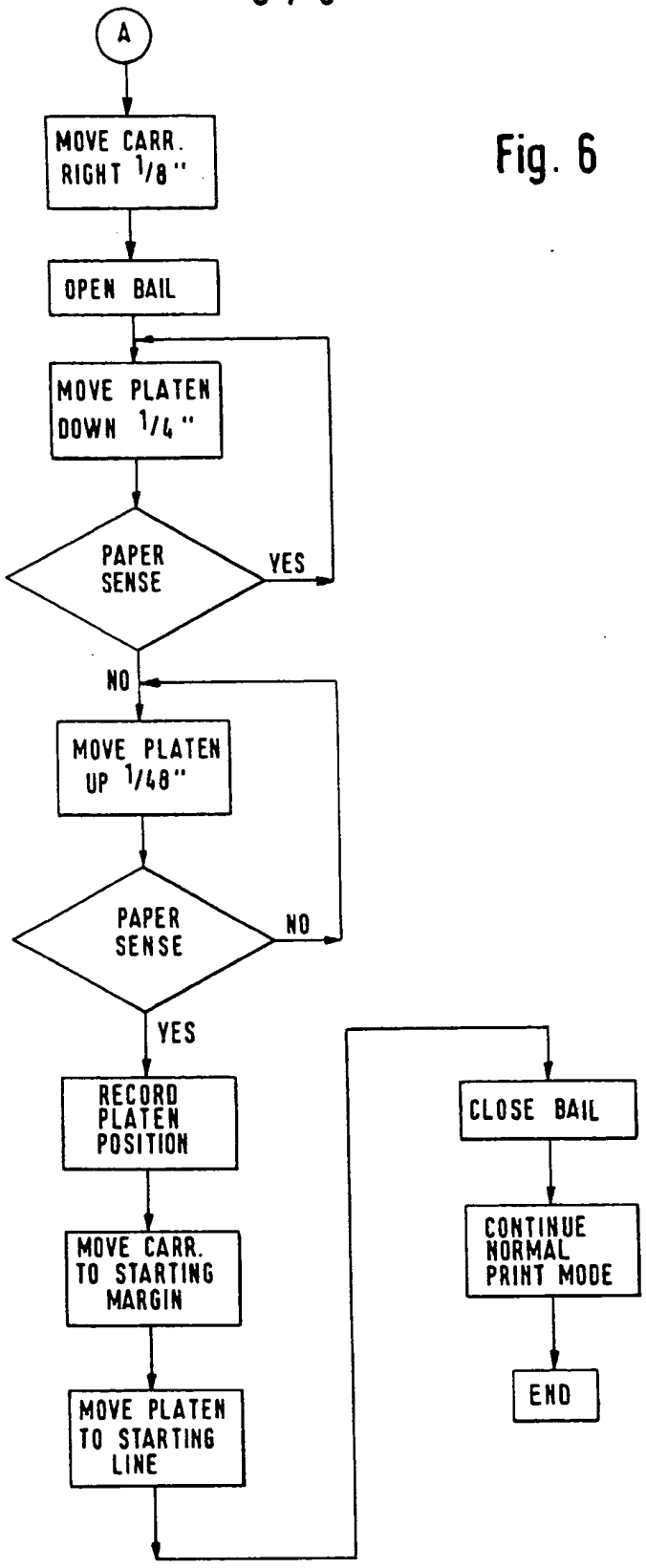

A
MOVE CARR. RIGHT 1/8"
OPEN BAIL
MOVE PLATEN DOWN 1/4"
PAPER SENSE
YES
NO
MOVE PLATEN UP 1/48"
PAPER SENSE
NO
YES
RECORD PLATEN POSITION
MOVE CARR. TO STARTING MARGIN
MOVE PLATEN TO STARTING LINE
CLOSE BAIL
CONTINUE NORMAL PRINT MODE
END

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0015553
EP 80 10 1124

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 20, no. 10, March 1978, pages 3996/3997. W.J. WIPKE: "Right hand margin set and print inhibit". * Whole document *	1,5,6
	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 20, no. 11a, April 1978, pages 4266/4269. E.T. BROWN et al. "Side-of-forms, end-of-forms, and forms jam-detection scheme for printers". * Whole document *	1,6,9, 10,14
A	US - A - 3 779 440 (W.R. CASALE) * Whole document *	1
A	US - A - 4 034 209 (TOSHIO KASHIO) * Column 1, line 65 to column 2, line 18; figures *	1
P	FR - A - 2 409 155 (A.E.S. WORDPLEX LTD.) * Page 2, line 16 to page 7, line 4; figures 1-6 *	1,10-14

CLASSIFICATION OF THE APPLICATION (Int. Cl.)

B 41 J 29/42
11/46

TECHNICAL FIELDS SEARCHED (Int.Cl.)

B 41 J

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A. technological background
O: non-written disclosure
P: intermediate document
T. theory or principle underlying the invention
E. conflicting application
D: document cited in the application
L. citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14-05-1980	V.D. MEERSCHAUT

EPO Form 1503.1 06.78

DOCKET NO: HK-777
SERIAL NO:
APPLICANT: J. A. Fischer et al.

LERNER AND GREENBERG P.A.
P.O. BOX 2480
HOLLYWOOD, FLORIDA 33022
TEL. (954) 925-1100